

Effectiveness in Erosion and Sediment Control: New Initiatives in Indianapolis

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Since the late 1960s, when the severity of pollution from sediment from construction sites was first documented, many states and municipalities have worked to develop effective programs for erosion and sediment control. These state and local programs were augmented in 1987, when Congress required in the Clean Water Act that operators of all construction sites over five acres prepare erosion and sediment control plans and obtain National Pollution Discharge Elimination Permits (NPDES). At that time, some states, such as Maryland and North Carolina, already had well-supported, comprehensive approaches that were developed largely in response to state law. Other states, including Indiana, have relatively new programs that were adopted only after the federal mandate. In general, these newer programs are not as comprehensive, and managers are still working to develop systematic and effective methods for implementation.

This paper describes a new initiative in Indianapolis, Indiana, to increase the effectiveness of erosion and sediment control programs. The paper describes a general framework for evaluating erosion and sediment control programs. Next, it describes an intergovernmental, "S.W.A.T." team approach to inspection that was used in Indianapolis in the summer of 1998. The paper summarizes the results of the inspections and concludes with a discussion of the implications for managers of erosion and sediment control programs.

Effectiveness in Erosion and Sediment Control Programs

Managers and analysts in Maryland and North Carolina have used a general framework for evaluating erosion and sediment control programs (Clevenger, n.d.; Departments of Civil Engineering and City and Regional Planning, 1990). The framework comprises five criteria, each of which must be satisfied for sediment pollution to be controlled effectively:

- Complete coverage
- Competent plans
- Careful installation
- Continual maintenance
- Consistent enforcement

Overall effectiveness requires that the coverage rate (the proportion of construction sites with controls) approach 100%. Operators of development sites must know of regulatory requirements and make efforts to comply. Second, erosion and sediment control plans must be competent. Best management practices (BMPs) incorporated into plans by engineers or technicians must be able, if constructed properly, to control erosion and sedimentation. Third, BMPs must be installed completely and correctly. Improper installation may result in failure and off-site sedimentation. Fourth, BMPs must be

maintained for the duration of the construction process. Finally, consistently effective approaches to enforcement must be developed to ensure compliance with substantive criteria. If any one of these criteria is not met, the objectives of erosion and sediment control may not be achieved.

When new programs are developed, these criteria can be considered sequentially. That is, when building a new program, managers must first make sure that developers and builders are aware of regulatory requirements. Next, they must work to ensure that developer's engineers are preparing good plans. If developers are aware of requirements and are submitting good plans, attention can turn to installation and maintenance. Use of enforcement tools always is a last resort.

An Initiative in Indianapolis

Although the City of Indianapolis has a sediment control ordinance that predates federal requirements, erosion and sediment control programs in Indiana have largely been developed in response to a state regulation [Title 327-IAC 15-5 (Rule 5)], that was adopted in 1992 to comply with EPA regulations. Since the adoption of Rule 5, managers generally have seen improvements in efforts to comply. Most developers and builders are now aware of requirements, and coverage is approaching 100%. With respect to plan review, the Division of Permits in the Department of Capital Asset Management (DCAM) is responsible for plan review pursuant to the city's ordinance, while, under a memorandum of understanding with the Indiana Department of Environmental Management (IDEM) and the Department of Natural Resources (IDNR), the Marion County Soil and Water Conservation District (District) is responsible for plan review pursuant to Rule 5. MCSWCD reviewers estimate that the quality of plans is improving, but that as many as 60 to 70% of all plans still must be returned and revised before approval. Most plans are approved on the second iteration.

Although the review process now assures that competent plans are being prepared, installation often remains inadequate, BMPs often are not maintained, and resources for inspection and enforcement are limited. IDNR has only seven inspectors in the Division of Soil Conservation for all 92 counties and 550 municipalities. IDNR inspectors generally work individually within regions, inspecting sites sequentially and in response to complaints. District personnel lack enforcement authority and mainly visit sites in response to complaints. In Indianapolis, sediment control has been a low priority with DCAM, which has no inspectors trained in or assigned exclusively to enforcement of sediment control requirements.

Managers have struggled to find ways to overcome resource limitations and to increase the effectiveness of implementation. In 1998, IDNR and District staff conceived of a "S.W.A.T." team approach to inspection. In this approach, all IDNR inspectors and District staff together focused their efforts on all open construction sites in the county. The objective was to visit all sites in a brief time period, thereby increasing the visibility of the program. Managers believed that intensive scrutiny of the county, if only for a brief time, would result in greater efforts at compliance. One of the assumptions on which this approach was based was that there are both formal and informal networks among developers and builders and that this approach would stimulate discussion about compliance issues.

In Indianapolis, IDNR and District personnel completed a county-wide survey of construction sites on June 23 and 24, 1998 (Hayes and Matthieu 1998). DCAM staff was invited to participate. IDNR, District, and DCAM staff visited more than 300 construction sites. Of these sites, 177 were active and were evaluated for compliance with Rule 5. Construction had not yet begun at 23 of the sites, construction had been completed at 61 sites, and the remainder were not evaluated because they were inaccessible or because construction was just beginning. This summary is restricted to the sites under active construction. The results provide a good picture of the current status of implementation and the general level of effectiveness of erosion and sediment control requirements in Indianapolis.

Inspectors evaluated sites for compliance in nine categories using a standardized checklist developed by IDNR. Sites also were checked for obvious evidence of off-site sedimentation. The nine categories were: (1) proper installation of erosion and sediment control measures; (2) perimeter erosion control measures; (3) erosion and sediment control measures on individual building sites; (4) protection of storm-sewer inlets; (5) stabilization of disturbed areas, (6) proper stabilization of drainage channels; (7) stabilization of drainage outlets; (8) maintenance of existing erosion and sediment control measures; and (9) tracking or accumulation of sediment on roadways. These criteria generally can be grouped within the installation and maintenance stages of the evaluation framework outlined above, although most involve

aspects of both installation and maintenance. The first seven criteria primarily concern installation of BMPs; only two, maintenance and tracking, primarily concern maintenance.

Inspectors rated each applicable criterion at each site on a scale of Satisfactory, Marginal, Unsatisfactory or not applicable (NA). Items in compliance with Rule 5 were rated S, items that were in danger of becoming out of compliance were rated M and items in violation of Rule 5 were rated U. Because all criteria were not applicable at all of the sites, the number of sites evaluated for with respect to each criterion varies.

Disturbing Results from Disturbed Sites

The results of the inspections are summarized in Figure 1 (Hayes and Matthieu 1998). Overall the results show that installation is inadequate and that maintenance is worse. Improvements in implementation clearly are needed. Discussion of each of the nine items reviewed follows.

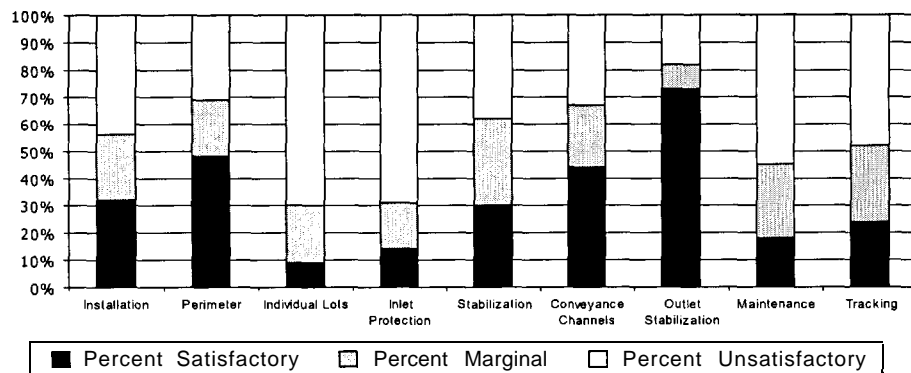


Figure 1. Rule 5 Compliance Summary-Percent of Applicable Sites.

Installation of Erosion Control Measures

Erosion control depends upon installation of appropriate control practices in given situations. Examples of these practices include silt-fence perimeter controls, sewer inlet and outlet protection devices, and the use of stone or mulch to stabilize slopes. Proper installation of these devices and practices helps reduce the risk of failure that may result in erosion and off-site sedimentation. Erosion and sediment control measures were installed correctly at only 32% of the active sites. Installation was marginal at 24% of the sites and had been done incorrectly at 44% of the sites. Proper installation was marked not applicable in cases where no erosion control practices were in use.

Perimeter Erosion Control Measures

Perimeter erosion control measures are designed to keep sediment from leaving a site directly at its perimeter through sheet or gully erosion. Perimeter erosion control devices/practices such as silt fence or buffer strips should be installed before land disturbance begins. The most effective and cost-efficient perimeter control practice is to leave existing vegetation in place, especially along waterways. Perimeter measures were installed and in compliance at 48% of the sites. Marginal conditions were found at 21% of the sites, and 31% of the sites were found to be out of compliance. Perimeter erosion control measures were not applicable at level or inward-sloping sites.

Individual Building Sites

Under Rule 5, erosion control is the responsibility of the site operator, either the developer or builder, throughout construction. At some sites, after the infrastructure has been installed and the lots have been sold to individual builders, the developer no longer has direct control over erosion and sediment control practices on those lots. Builders and contractors may or may not install and maintain erosion control practices. Erosion control on individual building sites is a serious problem in Marion County. Erosion and sediment control measures on individual building sites at developments were found to be adequate at only 9% of the active construction sites. Measures were in marginal condition at 21% of the sites, and 70% of the sites were found to be out of compliance. Most of these sites lacked proper construction entrances, storm-sewer protection, and perimeter protection. This category was not applicable for sites that had not yet begun construction of homes.

Storm-sewer Inlet Protection

Sediment entering storm-sewer inlets significantly reduces the capacity of retention/detention basins and drainage channels to store and convey stormwater away from flood prone areas effectively. If sediment is not removed prior to site closure, the specified volume and dimensions of retention/detention basins that were approved by the City can change. Inlet protection measures are especially important when sediment is tracked into or allowed to accumulate in roadways where it is conveyed directly to sewer inlets. Using measures such as seeding and silt fence adjacent to inlets will prevent sediment from clogging inlet protection devices and accumulating in the streets. Storm-sewer inlets were adequately protected from sediment at just 14% of the construction sites. Sewer inlets were marginally protected at 17% of the sites, and inlet protection measures were inadequate and not in compliance at 69% of the sites. Inlet protection was not applicable to sites that had not completed sewer installation.

Stabilization of Disturbed Areas

Stabilization of disturbed areas on construction sites may be the single most important practice for reducing erosion and off-site sedimentation. The best practice for achieving stabilization is to leave vegetation in place wherever possible. If soil must be disturbed, stabilization is relatively easily accomplished through temporary seeding or application of erosion control blanket. Rule 5 requires that disturbed areas that will be inactive be temporarily seeded. Stabilization by seeding results in higher perceived value by potential buyers, offering developers a financial incentive to vegetate land as soon as possible once the infrastructure is in place. Of active sites that were visited, 30% were in compliance with Rule 5 with respect to stabilization of disturbed areas, while 32% of the sites were marginal and 38% were not in compliance. This category of compliance was not applicable to sites that were being actively cleared or nearly completed at the time of the visit.

Drainage Channel Stabilization

Ditches and swales designed to convey storm water away from development to natural drainage ways or storm-sewers are subject to severe erosion and deterioration if not adequately protected. Erosion and damage to conveyance channels results in off-site sedimentation of waterways. This can be avoided by stabilizing the soil in conveyance channels immediately with permanent seeding of grasses, or with stone, mulch, or straw cover. Conveyance channel stabilization was satisfactory at 44% of the sites, Approximately 23% of the sites had marginally protected channels and 33% of the sites had channels in unsatisfactory conditions. Conveyance channel stabilization was not applicable at sites that did not have or require channels or at those that did not yet have them constructed.

Outlet Stabilization

Storm-sewer and drainage channel outlets from a site need to be properly stabilized to prevent erosion and sedimentation of the banks and waters they empty into. Outlet stabilization is best accomplished by protecting the soil around the outlet with stone riprap, geotextile fabric, or with well-established vegetation. Outlet stabilization was satisfactory at 73% of active sites. Outlets were in marginal conditions at 18% of the sites and unsatisfactory at 9%. This

category was not applicable at sites that did not have outlets on the site or where infrastructure development was not yet completed.

Maintenance of Erosion Control Practices

Erosion control practices that have been installed properly must be maintained to be effective. In most cases, lack of maintenance results in the same effects as not employing erosion control practices at all. Examples of maintenance of erosion control practices include removing accumulated sediment from behind silt fence and reinforcing inlet protection after storms. Failure of erosion control practices allows sediment to leave construction sites via storm-sewers, drainage channels, roadways and sheet and gully erosion. An often-overlooked aspect of maintenance is removal of devices after work is completed. Maintenance of erosion control practices was satisfactory at only 18% of the sites. Maintenance was marginal at 27% of them, and there was little or no evidence of maintenance at 55% of the sites. Maintenance of erosion control measures was not applicable at sites that did not employ erosion or sediment control practices.

Sediment Tracking and Accumulation in Roadways

Soil and sediment in streets and roads are readily washed into sewers and drainage channels and can be a significant source of pollution. In addition, the sediment can be a traffic hazard with the potential for costly litigation against the local governments or developers. Sediment accumulated in roads is also unsightly and may discourage potential home buyers. Tracking and accumulation of soil in roads was kept to an acceptable level at 24% of the sites. Approximately 28% of the sites exhibited marginal compliance with the rule for keeping roads clear of sediment. Sites that were out of compliance with the rule made up 48% of this category. Large industrial sites where equipment was usually kept on site and residential sites that did not yet require extensive coming and going of vehicles were rated not applicable for sediment tracking.

Off-site Sedimentation

Sediment is the most abundant pollutant, by volume, in Indiana waters. Residential and commercial development sites are potential sources of high volume, sudden discharges of sediment that can cause problems for land owners down-stream of development. Besides the drainage and flooding problems caused by off-site sedimentation, sediment can obstruct and widen streams and erode stream banks. Sedimentation of the state's streams and rivers also causes habitat damage for many aquatic species. There were obvious signs of off-site sedimentation at 21% of the active sites. This figure is believed to be low, however, due to the large number of sites surveyed in a very short time. Only the most obvious cases were checked as displaying off-site sedimentation.

Observations and Implications: Priority-problem Solving

A number of observations that have important implications for managers of erosion and sediment control programs can be drawn from this inspection initiative. First, it is useful to consider the initiative in the more general framework for effectiveness in erosion control. Indiana regulations for erosion and sediment control first were adopted in 1992. Faced with implementation of a new regulation with few resources, IDEM, IDNR, and District staff first devoted efforts to education and ensuring complete coverage and competent planning. In late 1997 and early 1998, program managers determined that the plan review process was fairly well established and that additional effort needed to be devoted to installation and maintenance of BMPs. Because resource shortages preclude regular, periodic inspection, IDNR officials developed a S.W.A.T. team approach. Teams of state, district, and available municipal officials focused inspection efforts, visiting and inspecting as many sites as possible in a short time.

In Indianapolis, the results show that implementation generally is poor. Installation of erosion and sediment controls was unsatisfactory on 44% of all sites, and satisfactory on less than one-third. With the exception of outlet stabilization practices, which had been installed properly at nearly three-fourths of the sites, no practice was installed properly on more than half of the sites. Perimeter controls, a basic practice, were installed satisfactorily on fewer than half of the sites and they were unsatisfactory at almost one-third. Stabilization was satisfactory at less than one-third of the sites, inlet

protection had been installed properly at less than 15% of the sites, and controls on individual lots had been installed properly at just 9% of the sites where they were needed. It is clear that installation is deficient and that additional effort is needed to ensure that practices identified on plans are installed properly.

The inspections show that maintenance of erosion and sediment controls is even worse than installation. Inspectors determined that maintenance of controls was unsatisfactory on 55% of the sites and satisfactory on only 18%. Mud is being tracked on streets and washed into sewers and drainage channels on almost half the construction sites. Additional field work to ensure proper maintenance of BMPs is a critical need.

Although these results were disturbing, they were not unexpected. Program officials knew that implementation was inadequate and devised the S.W.A.T. team approach to provide a quick, comprehensive assessment of the status of implementation. Since the inspections, program managers have used the results as part of overall efforts to increase understanding of requirements for erosion and sediment control and to build commitment to the programs. City staff agreed to mail copies of inspection reports to all developers, and the district provided a summary of results to all city-county councilors.

The results provide information that program managers can use to establish priorities for problem solving and education. For example, installation of perimeter controls appears better than efforts to stabilize disturbed areas on site. Future inspections and educational efforts therefore can focus on the importance of stabilization. Similarly, since it appears that site operators are doing a fairly good job at stabilization of outlets, this requirement can be de-emphasized, and additional effort can be devoted to solving problems like installation of controls on individual lots that are not controlled by practices on the larger development site. More generally, as more people understand the different steps in the process of erosion and sediment control, implementation should become more effective.

The survey did not focus on discovering reasons behind compliance or non-compliance, but several inferences can be drawn from these data. First, the data and experience indicate that some developers are unaware of their obligation to control erosion and sedimentation and leave the permitting and erosion control planning to engineers and contractors. This can result in a lack of commitment to implementation. Second, some developers, engineers and contractors clearly do not yet understand the purpose and importance of implementing erosion and sediment control practices. Education is needed to increase their understanding and commitment. Third, some operators know the requirements of Rule 5, but do not take them seriously, ignoring the Erosion and Sediment Control Plan. For these individuals, enforcement action may be required. In addition, a general problem that was observed has to do with sequence of construction. All too often, land disturbance is beginning before erosion and sediment control measures are installed. More emphasis must be placed on installation of practices prior to earth disturbance, and site operators must learn to follow the sequence described on plans.

Given that resource shortages are likely to continue, problems in implementation are likely to continue and regulatory programs are likely to remain less effective than they could be. Steps that may be taken to increase effectiveness include making sure that the regulated community participates in on-site, pre-construction meetings that underscore the scope and importance of controls: increasing the visibility of IDNR and District staff and the frequency of their site visits; educating developers, engineers and contractors about erosion and sediment control practices and how to install and maintain them; and emphasizing the need for erosion and sediment control throughout the entire development process.

The S.W.A.T. team approach clearly does not solve the problems of a relatively new, understaffed erosion and sediment control program. But the approach is an effective way to obtain a significant amount of information in a short time, raise the visibility of erosion and sediment control programs, and help establish priorities for problem solving.

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